

CLAIMS

What is claimed is:

1. A variable gain control amplifier operative to produce an output signal in response to an input signal, comprising:
 - an amplifier stage including at least a first intermediate fixed gain stage, operative to produce a first intermediate signal in response to the input signal, and at least a second intermediate fixed gain stage operative to produce the output signal in response to the first intermediate signal;
 - a feedback circuit operative to produce a gain control signal in response to the output signal; and
 - a gain control circuit, operatively coupled to the first intermediate fixed gain stage and the second intermediate fixed gain stage, and operatively responsive to the gain control signal to control an amplitude of the intermediate signal.
2. The variable gain control amplifier of claim 1, wherein the gain control circuit automatically controls the amplitude of the intermediate signal to adjust a gain of the variable gain control amplifier in response to the gain control signal such that an amplitude of the output signal remains substantially constant for input signals above certain level.
3. The variable gain control amplifier of claim 1, wherein the gain control circuit reduces the amplitude of the intermediate signal to decrease a gain of the variable gain control amplifier, and increase the amplitude of the intermediate signal to increase the gain of the variable gain control amplifier.

4. The variable gain control amplifier of claim 1 wherein the feedback circuit further comprises a storage element including data representing a storage element table containing at least gain control data for producing the gain control signal in response to the output signal.

5. The variable gain control amplifier of claim 4, wherein:

the gain control circuit automatically adjusts the gain of the variable gain control amplifier in response to the gain control signal such that an amplitude of the output signal remains substantially constant,

wherein the gain control circuit reduces the amplitude associated with the intermediate signal level to decrease the gain of the variable gain control amplifier, and

wherein the gain control circuit increases the amplitude associated with the intermediate signal level to increase the gain of the variable gain control amplifier.

6. The variable gain control amplifier of claim 1, wherein the amplifier stage produces at least one of: a substantially constant gain for the first intermediate fixed gain stage, a substantially constant gain for the second intermediate gain stage, a substantially constant third order intercept harmonic, and a substantially constant noise figure within a range of variable gain of the variable gain control amplifier.

7. The variable gain control amplifier of claim 1, wherein the amplifier stage is at least one of: a single-ended amplifier, a differential amplifier, a cascade amplifier, and a cascode amplifier.

8. The variable gain control amplifier of claim 1 wherein:

the at least first intermediate fixed gain stage further includes:

a common emitter transistor including a base operative to receive the input signal, a collector, and an emitter operatively coupled to a first reference potential; and

wherein the at least second intermediate fixed gain stage further includes:

a common base transistor including a base operatively coupled to a second reference potential, an emitter coupled to the collector of the common emitter transistor and operative to produce the first intermediate signal, and a collector operative to produce the output signal in response to the first intermediate signal.

9. The variable gain control amplifier of claim 8, wherein the gain control circuit comprises:

a gain control transistor including a gate, a drain, and a source, wherein the gate is operative to receive the gain control signal, the drain is coupled to the collector of the common emitter transistor and the emitter of the common base transistor, via a first intermediate reactive element, wherein the drain of the gain control transistor varies the amplitude of the intermediate signal to control the variable gain of the variable gain control amplifier, wherein the source is operatively coupled to the first reference potential.

10. The variable gain control amplifier of claim 9, further comprising an isolation resistor operatively coupled between the drain and the source of the gain control transistor, wherein the drain of the gain control transistor reduces the amplitude of the

first intermediate signal to decrease the gain of the variable gain control amplifier, and the drain increases the amplitude of the first intermediate signal to increase the gain of the variable gain control amplifier.

11. The variable gain control amplifier of claim 9 wherein the drain of the gain control circuit automatically adjusts the gain of the variable gain control amplifier such that an amplitude of the output signal remains substantially constant.

12. The variable gain control amplifier of claim 8, wherein an internal gain of the common emitter transistor and an internal gain of the common base transistor remains substantially constant.

13. The variable gain control amplifier of claim 1 wherein:

the at least first intermediate fixed gain stage further includes:

a common source transistor including a gate, a drain, and a source operatively coupled to a first reference potential, wherein the gate is operative to receive the input signal; and

wherein the at least second intermediate fixed gain stage further includes:

a common gate transistor including a gate operatively coupled to a second reference potential, and a source coupled to the drain of the common source transistor to produce the first intermediate signal, a drain operative to produce the output signal in response to the first intermediate signal.

14. The variable gain control amplifier of claim 13, wherein the gain control circuit comprises:

a gain control transistor including a gate, a drain, and a source, wherein the gate is operative to receive the gain control signal, the drain is coupled to the drain of the common source transistor and the source of the common gate transistor, via a first intermediate reactive element, wherein the drain of the gain control transistor varies the amplitude of the intermediate signal level to control the variable gain of the variable gain control amplifier, and the source is operatively coupled to the first reference potential; and

an isolation resistor operatively coupled between the drain and the source of the gain control transistor.

15. The variable gain control amplifier of claim 1 wherein:

the at least first intermediate fixed gain stage further includes:

a first cascade common emitter transistor including a base operative to receive the input signal, a collector, and an emitter operatively coupled to a first reference potential; and

wherein the at least second intermediate fixed gain stage further includes:

a second cascade common emitter transistor including a base coupled to the collector of the first cascade common emitter transistor and operative to produce the first intermediate signal, a collector operative to produce the output signal in response to the first intermediate signal, and an emitter operatively coupled to the first reference potential.

16. The variable gain control amplifier of claim 15, wherein the gain control circuit comprises:

a gain control transistor including a gate, a drain, and a source, wherein the gate is operative to receive the gain control signal, the drain is coupled to the collector of the first cascade common emitter transistor and the base of the second cascade common emitter transistor via a first intermediate reactive element, wherein the drain of the gain control transistor varies the amplitude of the intermediate signal to control the variable gain of the variable gain control amplifier, the source is operatively coupled to the first reference potential; and

an isolation resistor operatively coupled between the drain and the source of the gain control transistor.

17. A variable gain control differential amplifier including a variable gain, operative to produce a noninverting output signal and an inverting output signal, in response to a noninverting input signal, and an inverting input signal, the variable gain control differential amplifier comprising:

a first common emitter fixed gain stage including:

a common emitter transistor including a base, a collector, and an emitter operatively coupled to a first reference potential, wherein the base is operative to receive the noninverting input signal;

a first common base fixed gain stage including:

a common base transistor including a base operatively coupled to a second reference potential, an emitter coupled to the collector of the common emitter transistor of the first common emitter fixed gain stage to form a noninverting intermediate node and operative to produce a noninverting intermediate signal in

response to the noninverting input signal, and a collector operative to produce the noninverting output signal in response to the noninverting intermediate signal;

 a second common emitter fixed gain stage including:

 a common emitter transistor including a base, a collector and an emitter operatively coupled to the first reference potential, wherein the base is operative to receive the inverting input signal;

 a second common base fixed gain stage including:

 a common base transistor including a base operatively coupled to the second reference potential, an emitter coupled to the collector of the common emitter transistor of the second common emitter fixed gain stage to form the inverting intermediate node and operative to produce an inverting intermediate signal in response to the inverting input signal, and a collector operative to produce the inverting output signal in response to the inverting intermediate signal;

 a feedback circuit operative to produce a gain control signal in response to the inverting output signal and the noninverting output signal; and

 a gain control circuit operatively coupled between the noninverting intermediate node and the inverting intermediate node and operative to control an amplitude of the inverting intermediate signal and an amplitude of the noninverting intermediate signal in response to the gain control signal.

18. A wireless device comprising:

 an antenna operative to receive an input signal;

a variable gain control amplifier having a variable gain and operative to produce an output signal in response to the input signal, the variable gain control amplifier comprising:

an amplifier stage including at least a first intermediate fixed gain stage operative to produce a first intermediate signal in response to the input signal, and at least a second intermediate fixed gain stage operative to produce the output signal in response to the first intermediate signal;

a feedback circuit operative to produce a gain control signal in response to the output signal;

a gain control circuit operatively coupled to the first intermediate fixed gain stage and the second intermediate fixed gain stage, and operatively responsive to the gain control signal to reduce an amplitude of the intermediate signal; and

a receiver operative to receive the output signal.

19. The wireless device of claim 18, wherein the gain control circuit automatically adjusts the gain of the variable gain control amplifier in response to the gain control signal such that an amplitude of the output signal remains substantially constant.

20. A method for controlling a variable gain of an amplifier, the method comprising:

producing an intermediate signal in response to an input signal by at least a first intermediate fixed gain stage;

producing an output signal in response to the intermediate signal by at least a second intermediate fixed gain stage;

producing a gain control signal in response to the output signal; and
controlling an amplitude of the intermediate signal in response to the
gain control signal.

21. The method for controlling the variable gain of the amplifier of claim 20, wherein in response to the gain control signal, the amplitude of the intermediate signal is automatically controlled such that an amplitude of the output signal remains substantially constant.

22. The method for controlling the variable gain of the amplifier of claim 20 wherein in response to the gain control signal, the method further comprising:

reducing the amplitude of the intermediate signal to reduce the variable gain; and

increasing the amplitude of the intermediate signal to increase the variable gain.